

# Summary

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The ASTM Symposium on Refractory Metals and Their Industrial Applications was conceived in order to provide a guide and a handbook on practical usage of these materials in today's complicated technology of industrial production. Seven papers were presented, six papers from producers and one from a user of refractory metals.

*Mullendore* and *Burman* give a brief review of the manufacture of tungsten and molybdenum respectively from ore to finish product. The important properties of each metal are given and a comparison of these properties with other materials is made. The uses of tungsten and molybdenum are given as they relate to their properties.

*Webster* covers the manufacture, properties, and uses of niobium. *Hunkeler* considers the application of tantalum in the chemical process industry. Additional information on the corrosion resistance of tantalum and niobium is provided by *Burns et al.* *Belz* discusses the use of tantalum and niobium for capacitors, super-conducting materials, piezoelectricity, and other electronic applications. A user's view on the applications of refractory metals in the chemical process industry is given by *Smallwood*.

The refractory metals have high melting points, relatively high tensile properties at elevated temperatures, and experience catastrophic oxidation in air at elevated temperatures. Molybdenum and tungsten have high elastic moduli, relatively poor ductility and, except for a limited number of environments, are not particularly outstanding in terms of corrosion resistance. Niobium and tantalum are ductile materials with oxide films that are responsible for their excellent corrosion resistance and electronic properties.

The refractory metals, despite relatively high cost and fabrication difficulties, have many engineering uses. Engineering applications of refractory metals are so varied that they will be found as filaments in the smallest light bulb and as linings of very large distillation columns. As more engineers and designers become familiar with the refractory metals the different applications are certain to increase.

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